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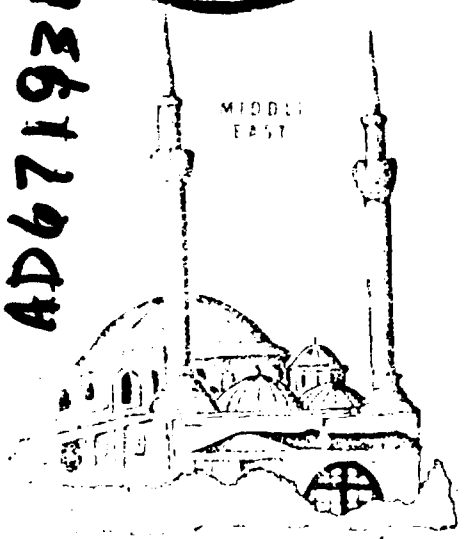

RESISTANCE LEVELS OF IZMIR, TURKEY
BEDBUGS AND COCKROACHES TO INSECTICIDES
1966-67

20 June 1968

Project Number 66-1

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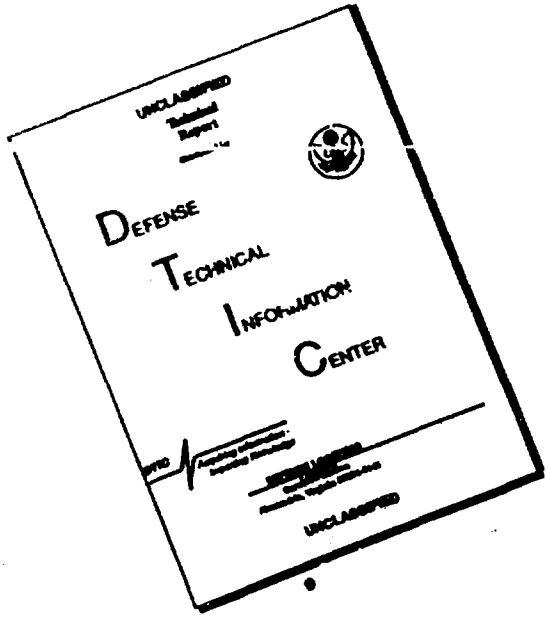

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The authors are especially indebted to SSgt Alan L. Morley for illustrations used in this study.

This report has been reviewed and is approved:

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DEPARTMENT OF THE AIR FORCE
TUSLOG DETACHMENT 36 (USAFE)
APO New York 09224

EPIDEMIOLOGY

Report No. 68-7

RESISTANCE LEVELS OF IZMIR, TURKEY BEDBUGS AND COCKROACHES TO INSECTICIDES 1966-67

20 June 1968

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PROJECT NO. 66-1

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ABSTRACT

During 1966, 67 and 68 tests were conducted with Bedbugs, Cimex lectularius, German cockroaches, Blatella germanica, and American cockroaches, Periplaneta americana strains obtained in Izmir Turkey during 1966-67 to determine their resistance to various concentrations of diazinon, malathion and dieldrin.

Results indicate that 0.5% diazinon should control bedbugs and 0.05% diazinon should control German cockroaches and 3.0% malathion should control American cockroaches. For combined German and American cockroach infestations we recommend 3.0% malathion in the absence of American/diazinon data.

TÜRKÇE ÖZET

1966, 1967 ve 1968 yıllarında Tahtakurusu Cimex lectularius, Alman hamam böceği, Blatella Germanica, ve Amerikan hamam böcekleri Periplaneta americana üzerinde deneyler yapılmış ve 1966-1967 yılları süresinde İzmir, Türkiye'de üretilen bu böceklerin muhtelif yoğunluktaki diazinon malthion ve dieldrin solusyonlarına karşı mukavemetleri araştırılmıştır.

Elde edilen neticelere göre 0.5% diazinon tahtakurularını, 0.05% diazinon Alman hamamböceklerini ve 3.0% malathion da Amerikan hamamböceklerini öldürmektedir. Alman ve Amerikan hamamböceklerinin birarada infestasyonu halinde şayet Amerikan/diazinon konusunda bilgi mevcut değilse 3.0% malathion solusyonu kullanılmasını tavsiye ederiz.

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EPIDEMIOLOGY

RESISTANCE LEVELS OF IZMIR, TURKEY BEDBUGS AND COCKROACHES TO INSECTICIDES 1966-67

With the continued development of physiological resistance of insects to insecticides in use at military installations it is important to keep abreast of the resistance problem. In order to provide current information on insect resistance, tests must be conducted on a continuing basis. Being cognizant of this problem and due to frequent requests for recommendations for the latest control data, preliminary laboratory resistance tests were conducted during 1966, 67 and 68 on bedbugs (Cimex lectularius) and cockroaches (Blatella germanica and Periplaneta americana) from Izmir, Turkey.

There is no evidence at the present time to indicate that bedbugs are natural vectors of diseases. However, it has been shown that they can experimentally transmit the pathogens of plague, relapsing fever, leprosy, Kala-azar, and chagas disease. They are of medical importance to the military however, because they can produce considerable irritation and discomfort from their bites. It has been shown that the german cocroach, Blatella germanica, can experimentally transmit bacteria (e.g. Salmonella typhimurium), fungi (e.g. Aspergillus) and serve as an intermediate host for nematode parasites (e.g. Spirura gastrophilia and Gongylonema neoplasticum).[1]

II

MATERIALS AND METHODS

The procedures used to determine the resistance of bedbugs and cockroaches to insecticides were those prescribed in Technical Information Memorandum No. 3, Methods for Determining the Susceptibility or Resistance of Insects to Insecticides, Armed Forces Pest Control Board, Washington, D.C., dated 30 January, 1959, and Test Methods for Insect Resistance, Supplement No. 2 to Armed Forces Manual on Pest Control, Defense Research Board, Department of National Defense, Canada, Ottawa 1967. These methods confine cockroaches and bedbugs to insecticide residues inside mason jars. Ebeling et al stated that the repellency of many contact insecticides used against German cockroaches greatly handicapped their field performance. They describe another method where German cockroaches were allowed a choice between an illuminated untreated area and a dark shelter partly or completely treated with insecticide. They found that themore potent, rapidly acting insecticides tended to be most repellent; so therewas a rough inverse correlation between the efficacy judged by the confinement and free choice methods. Our tests were limited to the confinement to insecticide residue method.[2]

Test concentrations for all insecticides were prepared from emulsifiable concentrate stock solutions. The American cocroach tests were replicated five times with five specimens per replicate. The German cockroach tests were replicated five times with 10 specimens per replicate. For each species, one of the above replicates was untreated and served as a control. The number of insects used per replicate was determined by the number available at the time the tests were conducted.

The results were plotted on logarithmic - probability paper. The regression line was fitted by eye to determine the lethal time required to knockdown 50% and 90% of the specimens. This time duration will hereinafter be referred to as LT50 and LT90.

Bedbugs: The bedbugs tested were from a colony established from five bedbugs obtained from the quarters of a military member in Izmir, Turkey in June 1967. The insecticides tested were diazinon at concentrations of .0001%, 0.01% and 1.0% and malathion at 1.0%. Test insects were all adult males.

German cockroaches: The cockroaches tested were from a colony established from specimens obtained from a civilian hotel in Izmir, Turkey in August 1966. The insecticides tested were diazinon at concentrations of 0.001%, 0.01%, 0.05%, malathion at concentrations of 0.05%, 0.5%, 5.0% and dieldrin at concentrations of 0.1%, 1.0% and 10.0%. Test insects were adult males.

American cockroaches: The cockroaches tested were from a colony established from specimens obtained from an infestation in the Microbiology section, Detachment 36 leased office and laboratory building Izmir, Turkey in May 1966. The insecticide tested was malathion at a 3% concentration. Test specimens were male, female and mature nymphs. Due to the long life cycle of this species there were only sufficient specimens to conduct a single test.

III

RESULTS

Data from the results of the insecticide resistance tests is presented below.

BEDBUGS (Cimex lectularius)	DIAZINON	KNOCKDOWN TIME	
Concentration (%)		LT50	LT90
0.0001		LT50 not reached at end of 72 hrs	
0.01		3:18*	No LT90 at end of 72 hrs
1.0		1:12	5:36 (atch 2)
Control		No mortality at end of 72 hrs	
	MALATHION		
1.0		1:24	2:18 (atch 3)
Control		No mortality at end of 72 hrs	

* 3 hrs 18 minutes

GERMAN COCKROACHES (Blatella germanica)	DIAZINON	KNOCKDOWN TIME	
Concentration (%)		LT50	LT90
0.001		2:50	4:12 (atch 4)
0.01		:48 min	1:18 (atch 5)
0.05		:48 min	1:12 (atch 6)
Control		No mortality at end of 12 hrs.	
	MALATHION		
0.05		2:48	5:48 (atch 7)
0.5		:36	:48 (atch 8)
5.0		:24	:40 (atch 9)
Control		No mortality at end of 12 hrs	
	DIELDRIN		
0.1		84 hrs	150 hrs (atch 10)
1.0		45 hrs	140 hrs (atch 11)
10.0		40 hrs	56 hrs (atch 12)
Control		No mortality at end of 150 hrs	

AMERICAN COCKROACHES (Periplaneta americana)	MALATHION	KNOCKDOWN TIME	
Concentration (%)		LT50	LT90
3.0		:30	:48 (atch 13)
Control		No mortality at end of 1 hr	

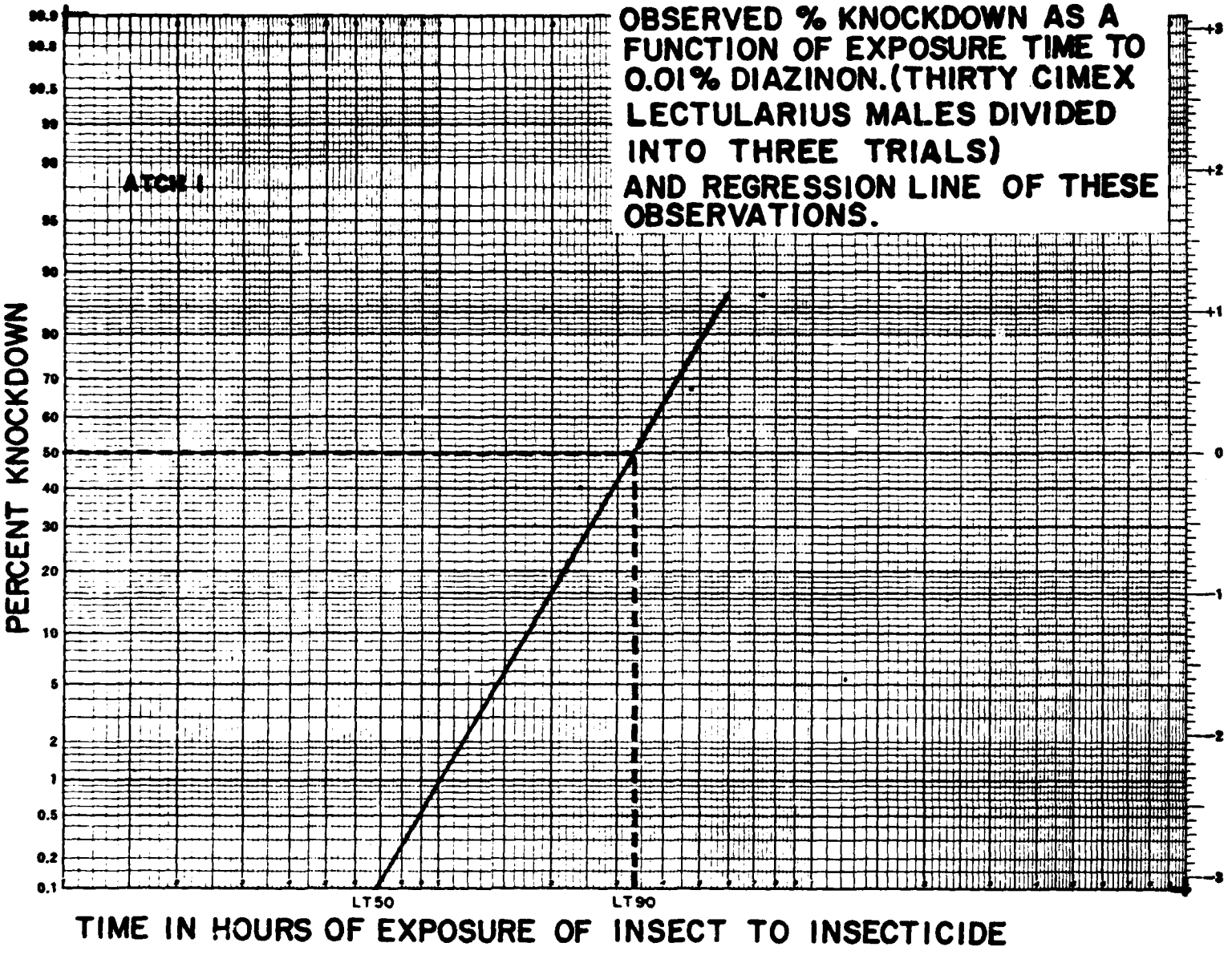
IV

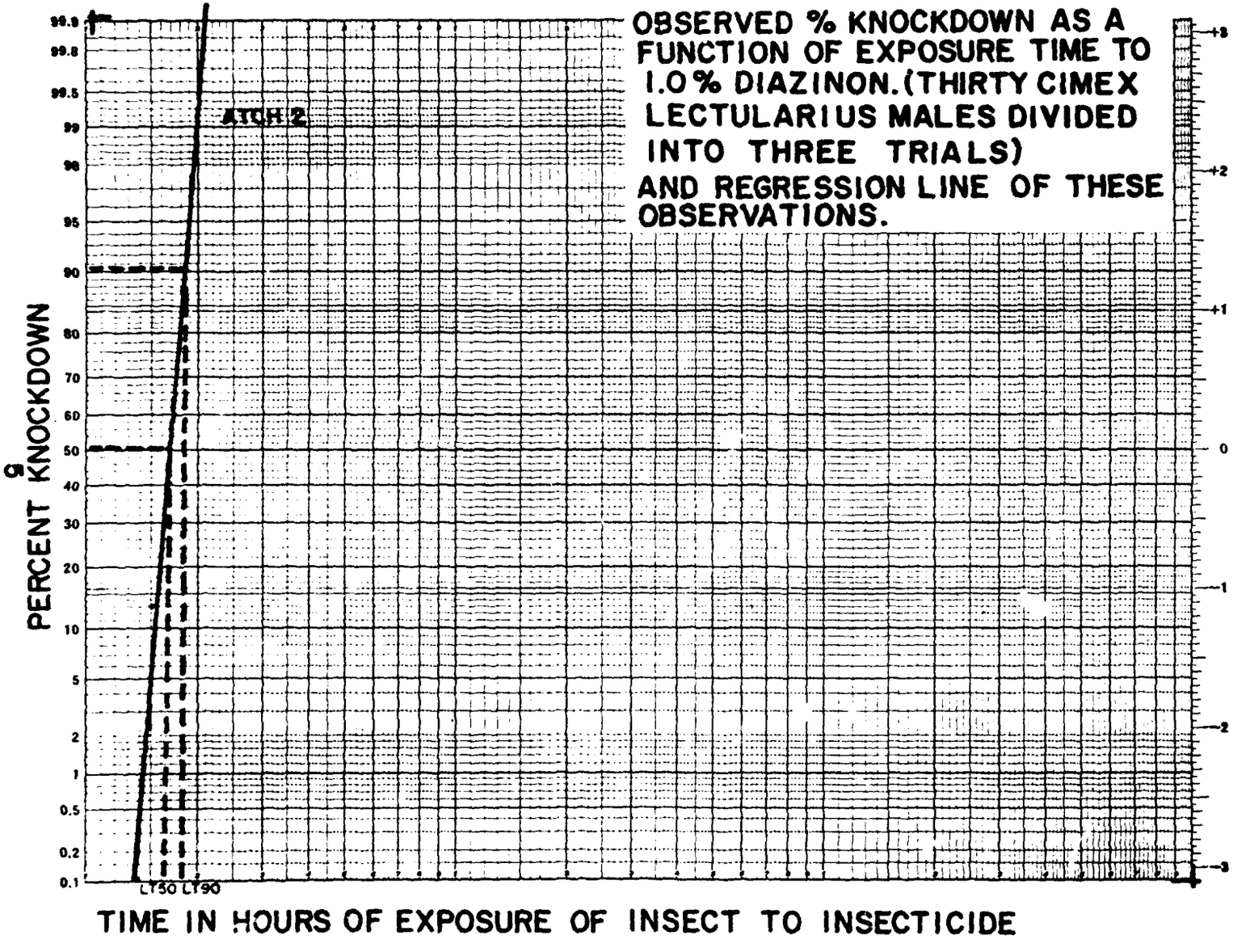
DISCUSSION AND CONCLUSIONS

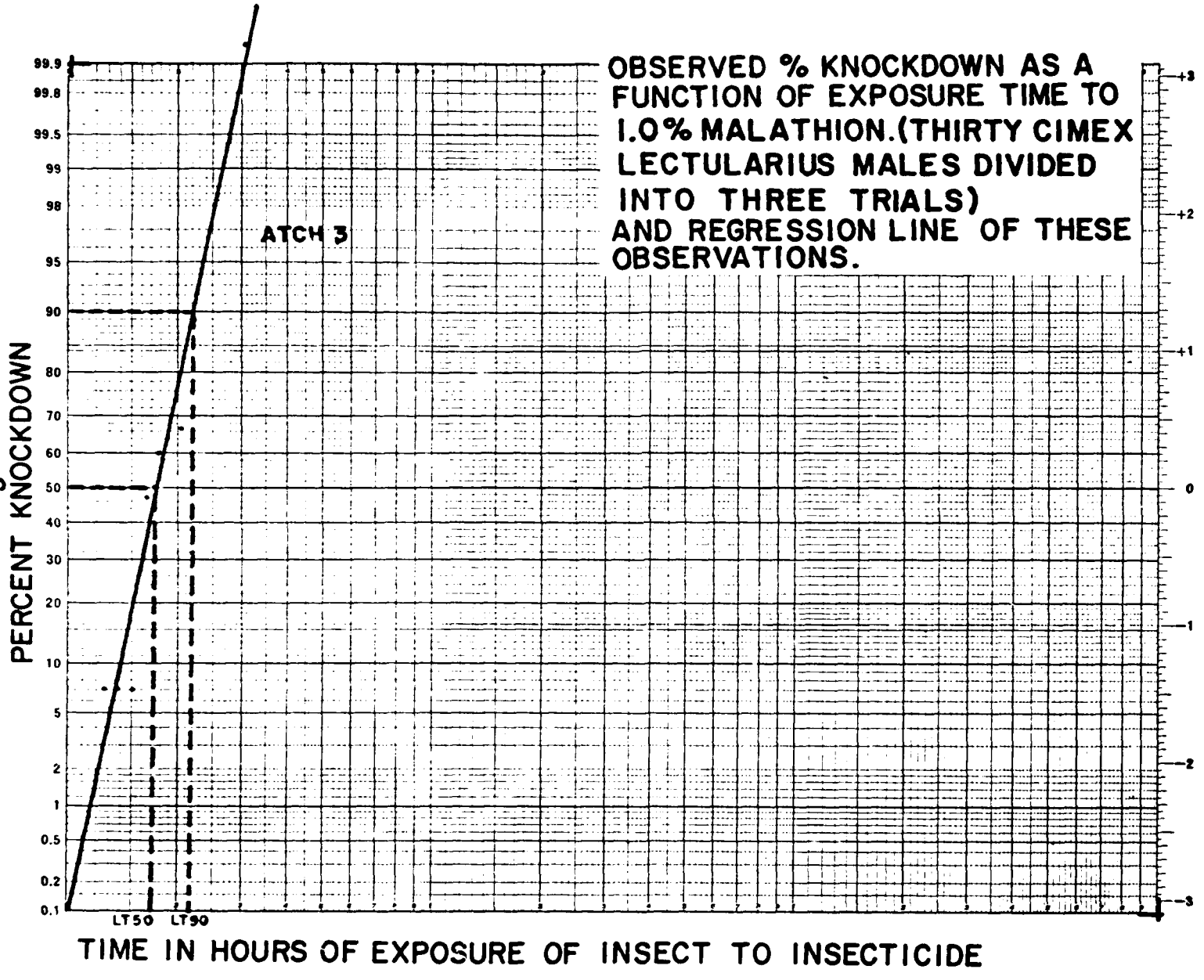
Bedbugs: These tests show that the Izmir strain of bedbugs was susceptible to 1.0% diazinon (LT50 - 1:12 and LT90 - 1:36). However, at a concentration of 0.01% the LT50 was reached at 3 hrs 18 min but 90% mortality was not attained and with 0.001% neither an LT50 or LT90 was reached. It appears that good control could be expected with 1.0% concentration or greater but control with lesser concentration would be doubtful. Good control could also be expected with 1.0% malathion concentration (LT50 - 1:24 and LT90-2:18) or greater. Results are not available on lesser concentrations.

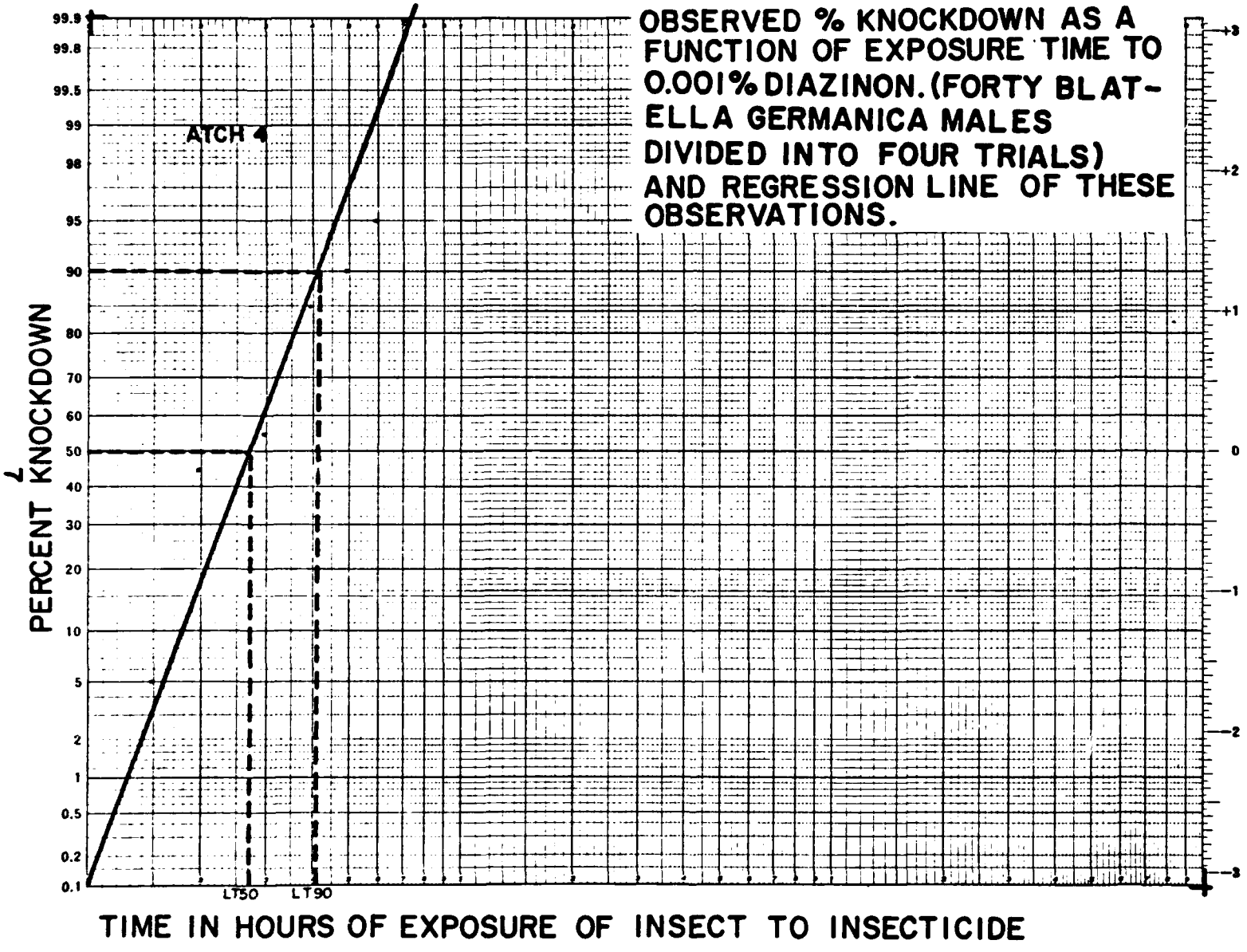
German cockroaches: The tests on the Izmir strain of German cockroaches showed that they were susceptible to concentrations as low as 0.001% diazinon (LT50 - 2.50 and LT90 - 4:12) and 0.5% malathion (LT50 - 2.48 and LT90 - 5:48). Just the opposite appears to be true with 10.0% dieldrin (LT50 - 40 hrs and LT90 - 56 hrs). From these results it appears that good control could be obtained with both diazinon and malathion, but resistance is indicated with dieldrin.

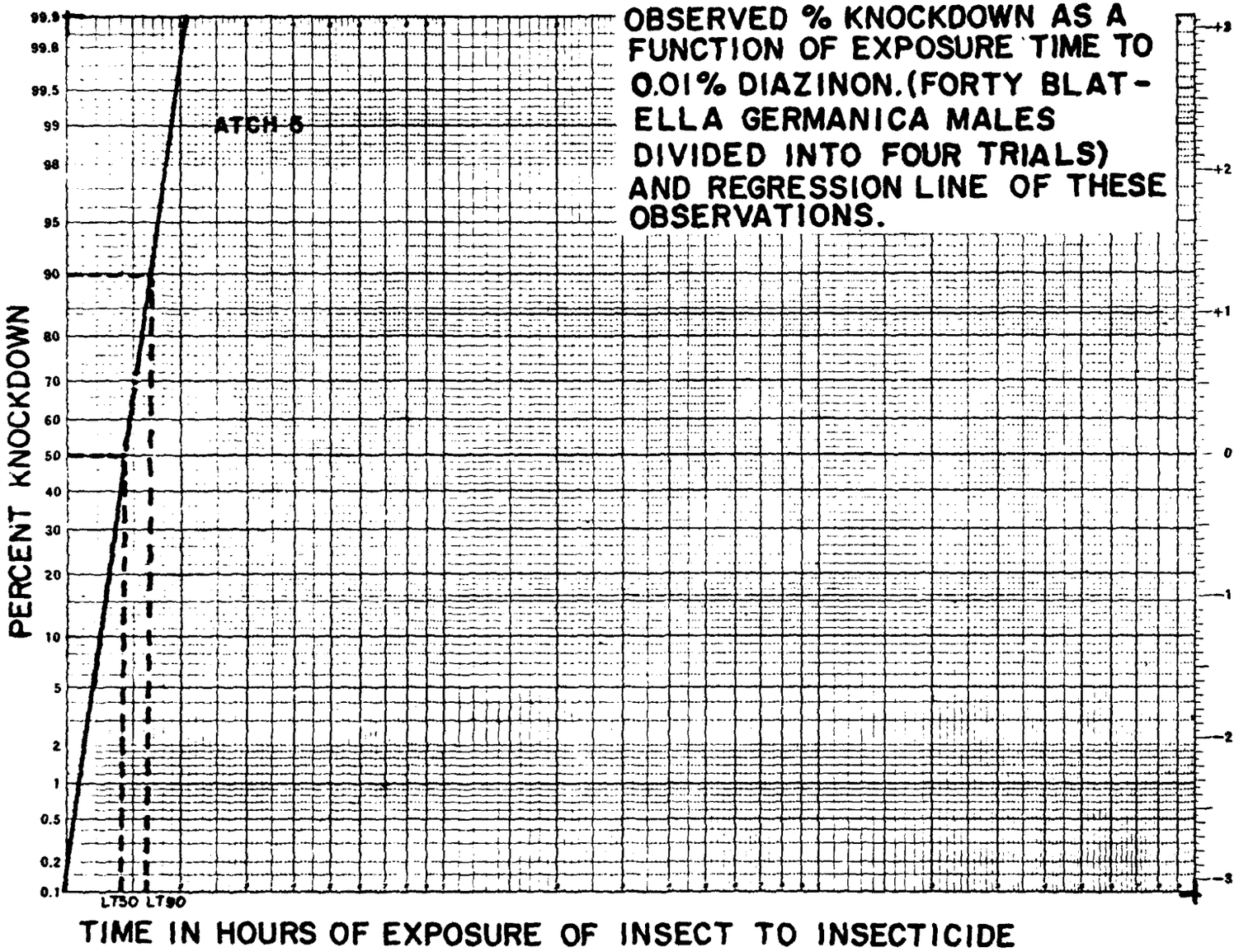
American cockroaches: Due to a shortage of cockroaches only one test (3% malathion) was conducted with American cockroaches. They were highly susceptible to this concertration with an LT50 at 24 minutes and LT90 at 40 minutes. Additional tests are indicated with lesser concentrations to obtain more meaningful data.

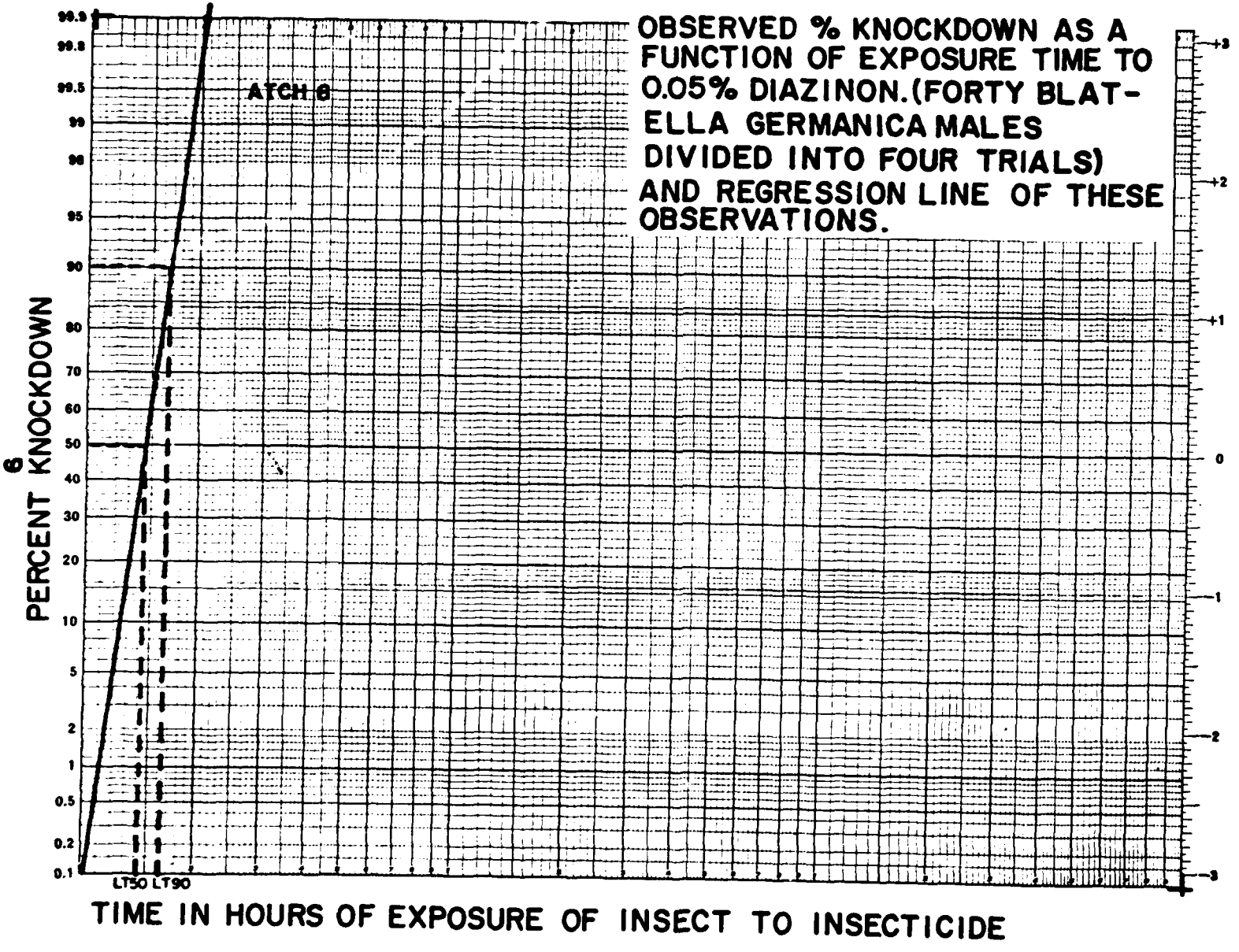

OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.01% DIAZINON. (THIRTY CIMEX LECTULARIUS MALES DIVIDED INTO THREE TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
ATCK I
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50
LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

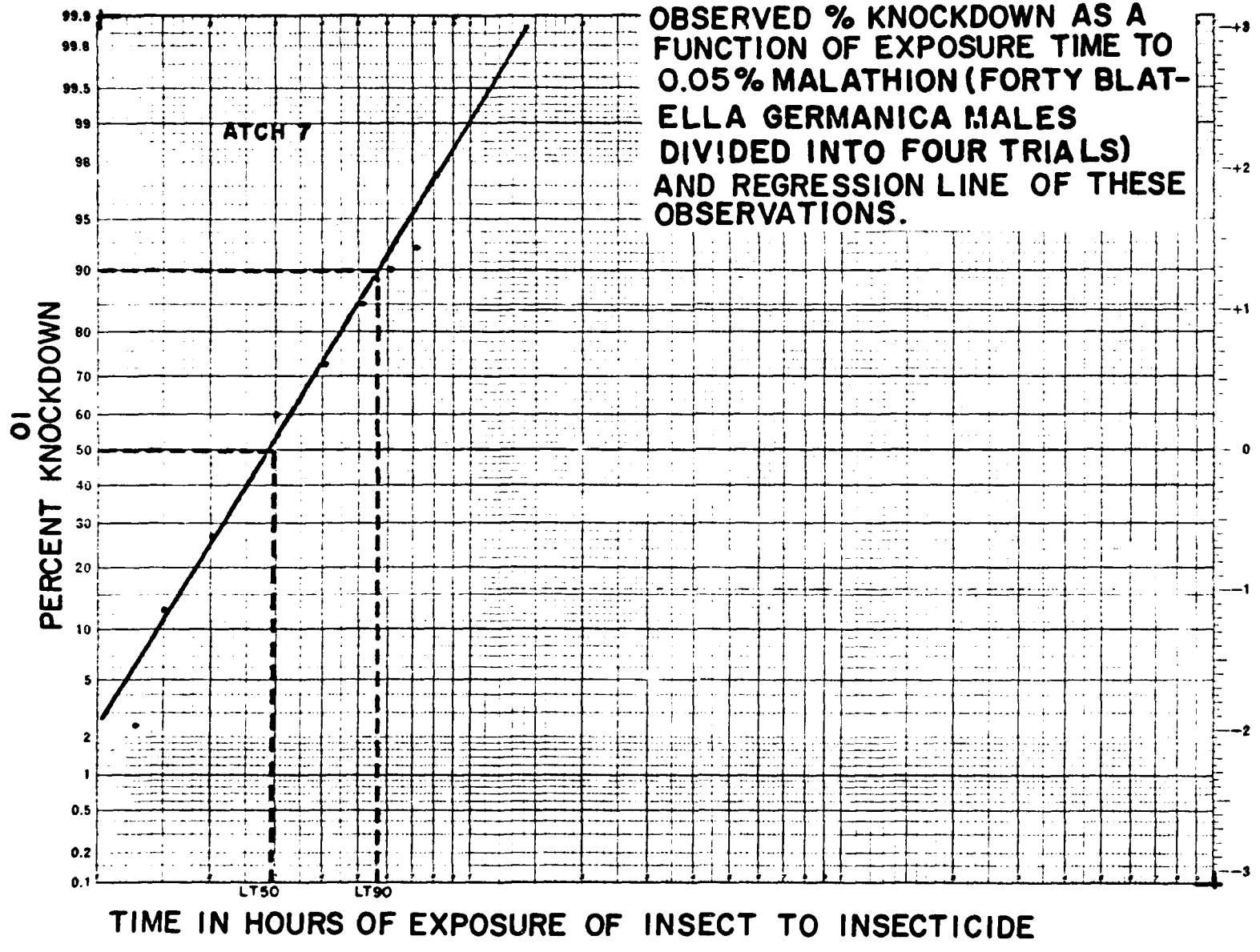

ATCH 2
OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 1.0% DIAZINON. (THIRTY CIMEX LECTULARIUS MALES DIVIDED INTO THREE TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50 LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

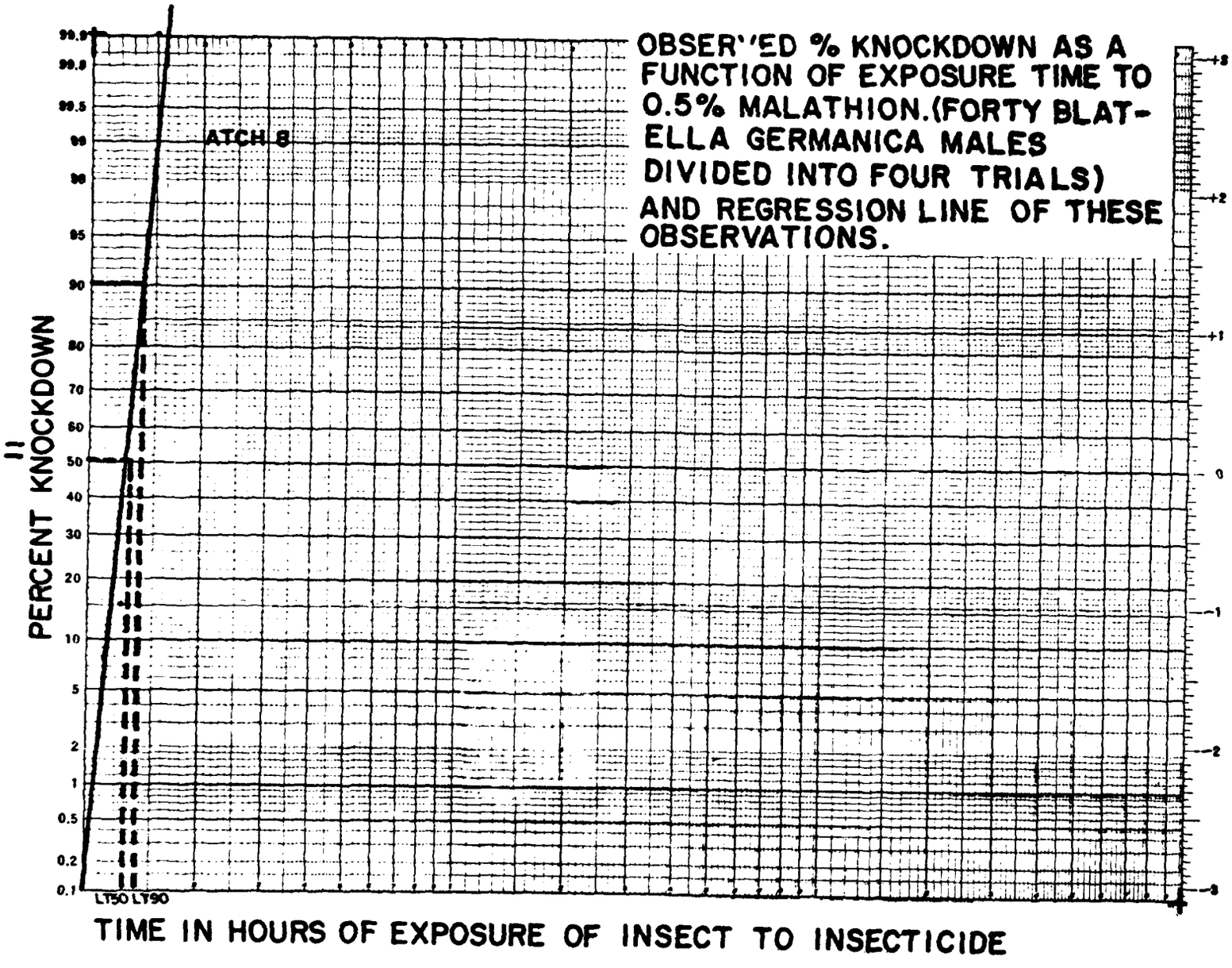

OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 1.0% MALATHION.(THIRTY CIMEX LECTULARIUS MALES DIVIDED INTO THREE TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
ATCH 3
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50
LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.001% DIAZINON. (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
ATCH 4
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50
LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.01% DIAZINON. (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
ATCH 6
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50 LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


ATCH 6
OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.05% DIAZINON. (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50 LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.05% MALATHION (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
ATCH 7
01 PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50
LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE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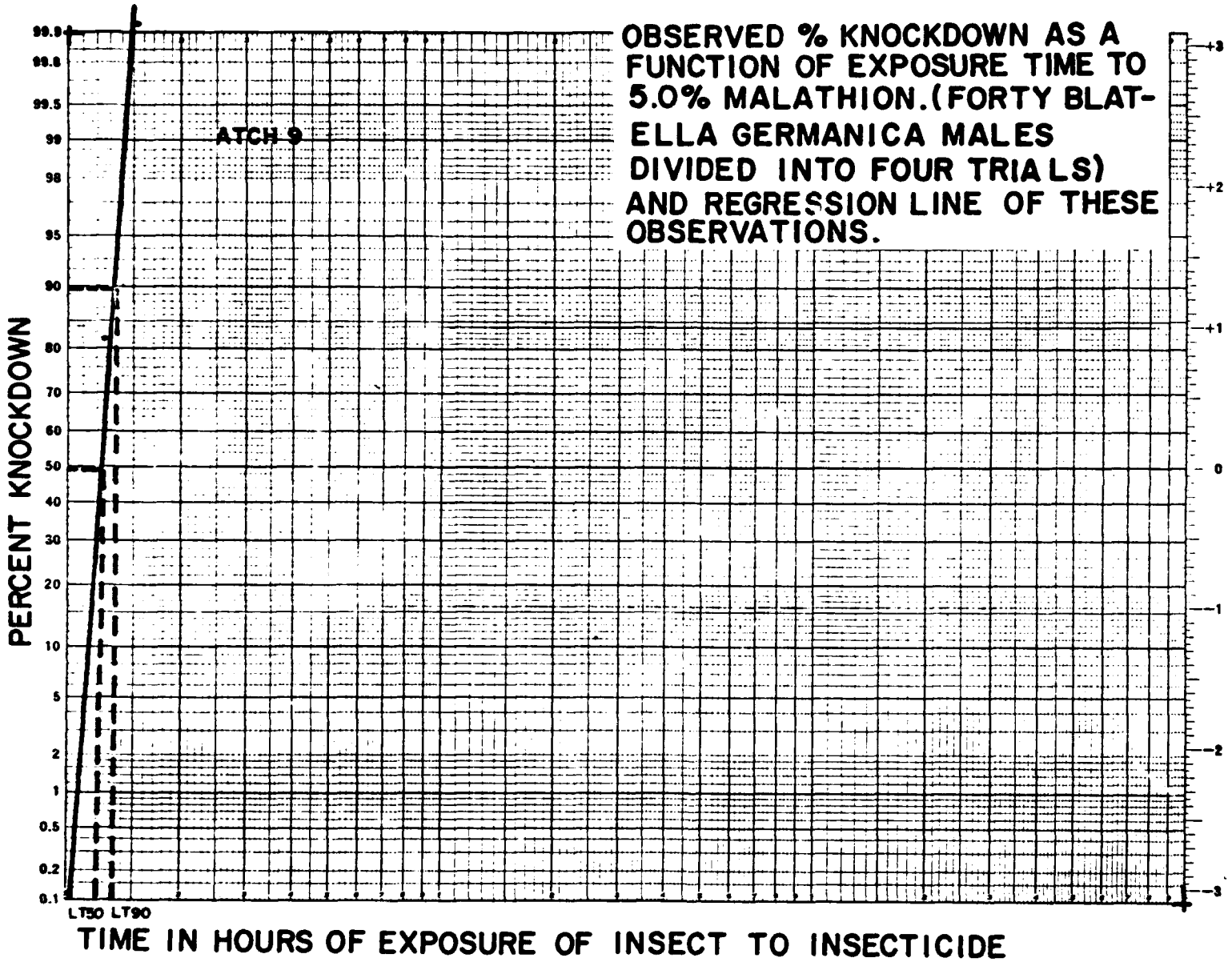
ATCH 8
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
LT50 LT90
+3
+2
+1
0
-1
-2
-3
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE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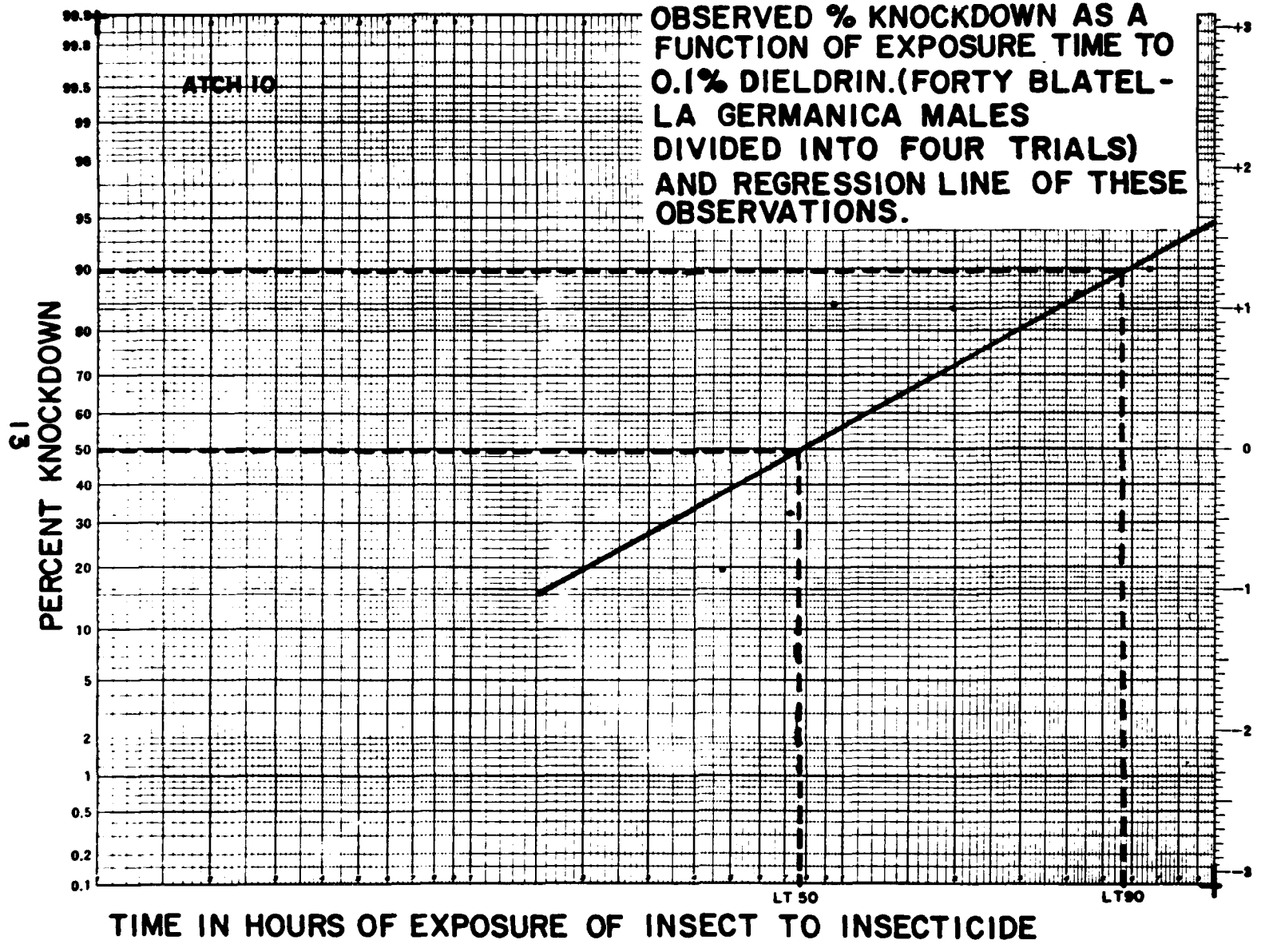
OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 5.0% MALATHION. (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50 LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE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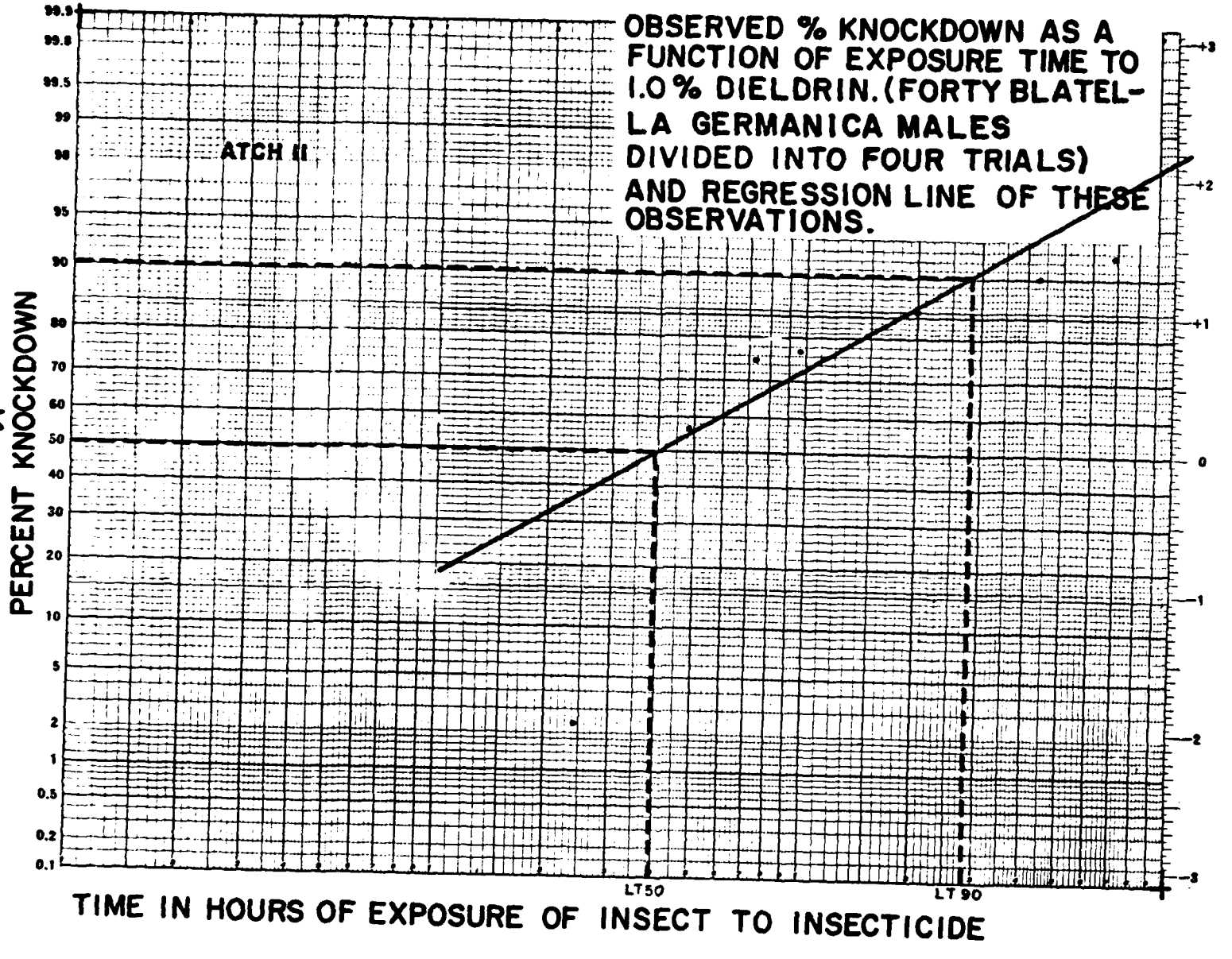
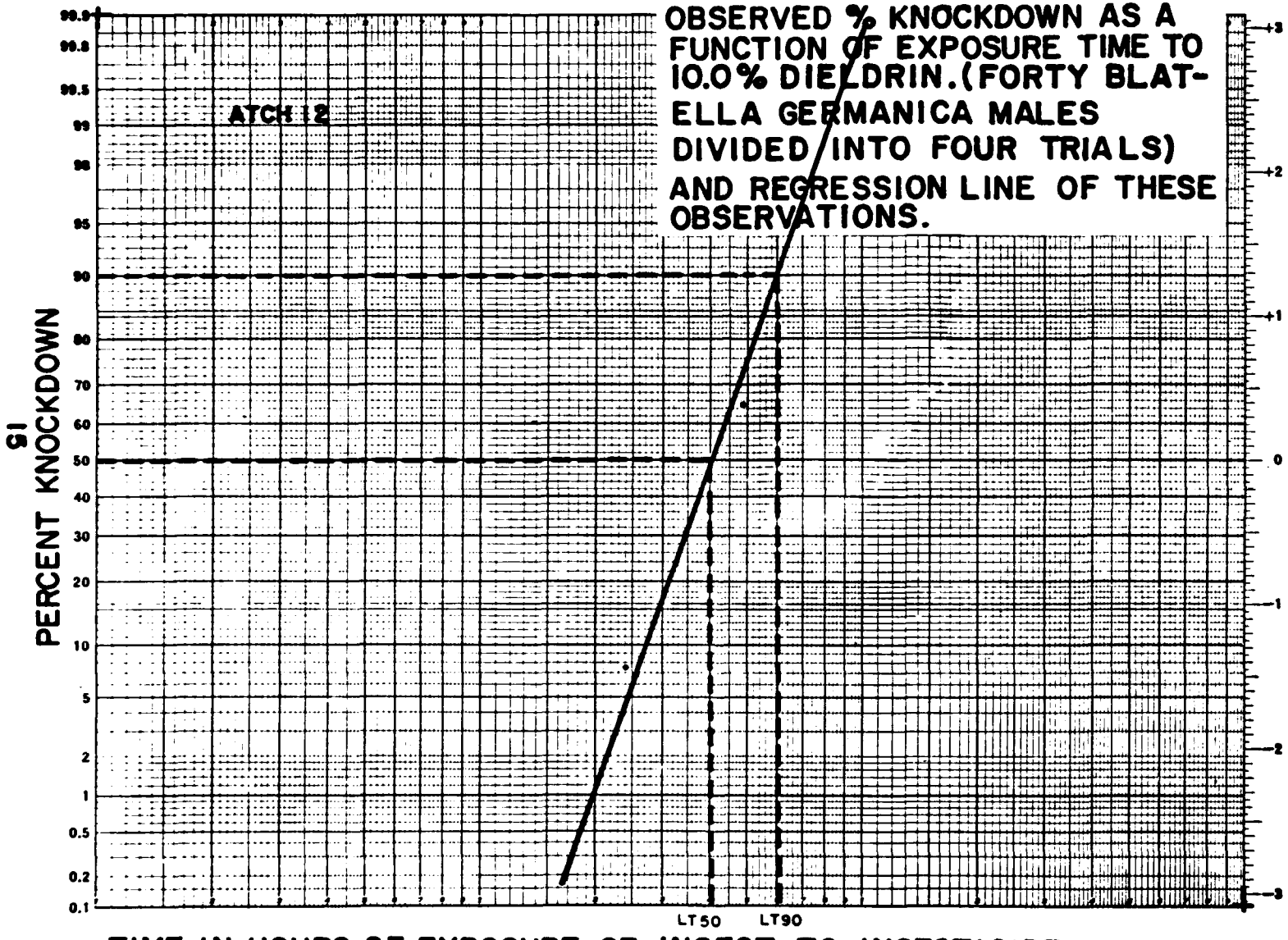
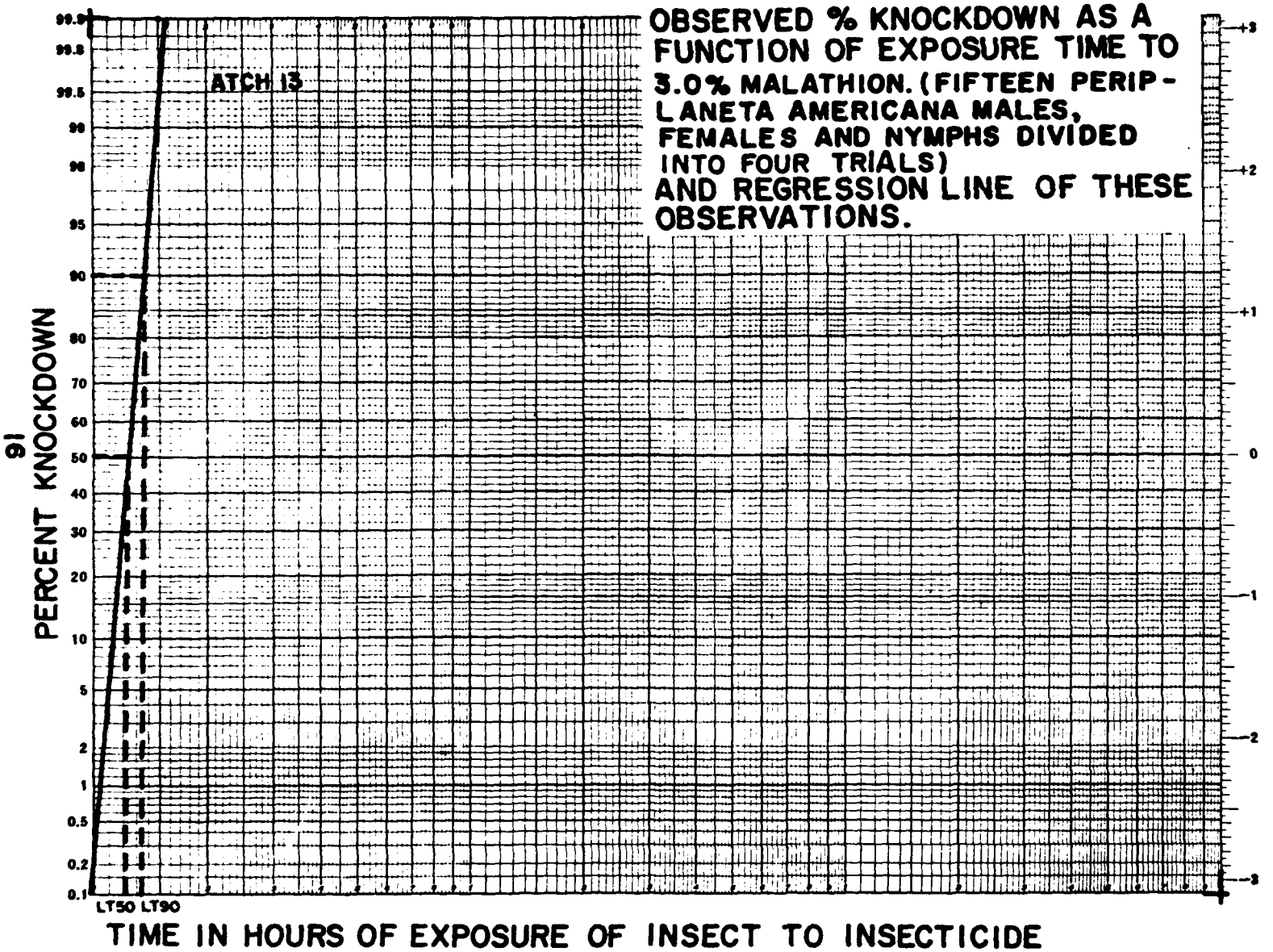
OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 0.1% DIELDRIN.(FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT 50
LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 1.0% DIELDRIN. (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
ATCH II
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50
LT 90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


ATCH 12
OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 10.0% DIELDRIN. (FORTY BLATELLA GERMANICA MALES DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
PERCENT KNOCKDOWN
SI
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50
LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE


ATCH 13
OBSERVED % KNOCKDOWN AS A FUNCTION OF EXPOSURE TIME TO 3.0% MALATHION. (FIFTEEN PERIPLANETA AMERICANA MALES, FEMALES AND NYMPHS DIVIDED INTO FOUR TRIALS) AND REGRESSION LINE OF THESE OBSERVATIONS.
91
PERCENT KNOCKDOWN
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
+3
+2
+1
0
-1
-2
-3
LT50 LT90
TIME IN HOURS OF EXPOSURE OF INSECT TO INSECTICIDE

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13. ABSTRACT

[illegible], 67 and 68 tests were conducted with Bedbugs, Cimex lectularius, Cockroaches, Blattella germanica and American cockroaches, Periplaneta americana from obtained in Izmir Turkey during 1966-67 to determine their resistance to various concentrations of diazinon, malathion and dieldrin.

[illegible] 0.5% diazinon should control bedbugs and 0.05% diazinon should control cockroaches and 5.0% malathion should control American cockroaches. [illegible] controlled [illegible] and American cockroach infestations were [illegible] in the absence of Asiatic/diazinon data.

DD 1473

UNCLASSIFIED

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Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Cockroaches						
Bedbugs						
Resistance						
Susceptibility						
Diazinon						
Malathion						
Dieldrin						
Izmir, Turkey						